

NON-PUBLIC?: N
ACCESSION #: 9411250216
LICENSEE EVENT REPORT (LER)

FACILITY NAME: South Texas Unit 1 PAGE: 1 OF 6

DOCKET NUMBER: 05000498

TITLE: Reactor Trip and Turbine Trip due to Low-Low Steam
Generator Level
EVENT DATE: 09/20/94 LER #: 94-015-01 REPORT DATE: 11/17/94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Jairo Pinzon - Staff Engineer TELEPHONE: (512) 972-8027

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On September 20, 1994, Unit 1 was in Mode 1 at 100% power. At 0105 hours, Unit 1 received an automatic reactor/turbine trip due to Steam Generator 1C low-low level. Immediately prior to the unit trip, efforts were in progress to reduce Reactor Power and Turbine Load following the unanticipated trip of the #13 Steam Generator Feedwater Pump. The cause of this event was that management expectations, procedural guidance, training, and personnel experience placed initial emphasis on expected plant response rather than actual plant conditions. This event was initiated when Steam Generator Feedwater Pump tripped on overspeed due to a failed speed feedback device (Tachometer Pack) in the speed control circuits. Contributing causes were determined to be inadequate communications and the Start-up Feedwater Pump recirculation valve not closing due to a coarse gain misadjustment on the flow controller card in the Miscellaneous Analog Cabinet and internal damage on the valve. Corrective actions include discussing managements expectations regarding

the use of all indications for proper equipment operations and crew communications with the involved crew, revising the off-normal procedure, replacing a failed speed sensor, ensuring proper operation of the Start-up Feedwater Pump Recirculation Valve, developing a scenario similar to this event for the simulator and including this event in Operators lessons-learned training.

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END OF ABSTRACT

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DESCRIPTION OF EVENT:

On September 20, 1994 Unit 1 was in Mode 1 at 100% power. At approximately 0105 hours, Unit 1 experienced a reactor trip on low-low Steam Generator level approximately four minutes after the loss of a Steam Generator Feedwater Pump.

At approximately 0101 hours, the plant computer recorded the Steam Generator Feedwater Pump 13 speed in the alert range high. Four seconds later, a speed high alarm was received. Two seconds later, Steam Generator Feedwater Pump 13 tripped due to overspeed.

Following the Steam Generator Feedwater Pump trip, initial actions contained in the "Loss of Feedwater Flow or Control" procedure were performed. As expected, the motor-driven Start-up Feedwater Pump started automatically and was verified running. A Feedwater Booster Pump was started to ensure sufficient suction pressure for Start-up Feedwater Pump operation and Turbine Generator output was reduced slightly to ensure adequate margin existed between 100% operation and the current feedwater pump configuration.

Approximately one minute later, attempts were still in progress to match steam flow and feedwater flow. Steam Generator level continued to decrease with a steam flow-feedwater flow mismatch. Further analysis of the situation identified that the Start-up Feedwater Pump Recirculation Valve had not closed (indicated intermediate-position on the Main Control Board). As a result, feedwater to the Steam Generators was diverted to the Deaerator. This did not allow sufficient feedwater flow to maintain Steam Generator level. Within two minutes, it was determined that generator load must be decreased to approximately 900 MWe, the main turbine controls were placed in manual, and the load reduction rate was increased in order to decrease steam flow to less than feedwater flow. As load was reduced, the steam dumps modulated open due to a Temperature

average-Temperature reference mismatch. Due to automatic rod insertion, steam dumps modulated in the closed direction, reducing steam flow below feedwater flow, and Steam Generator C level appeared to stabilize at approximately 37%. Upon closure of the dump valves, steam generator level shrunk below the low-low Steam Generator level trip setpoint (33%) and the reactor tripped.

The plant responded to the reactor trip as expected. Auxiliary Feedwater actuated on low Steam Generator level and Feedwater Isolation actuated on low average temperature coincident with a reactor trip.

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CAUSE OF EVENT:

The cause of this event was that management expectations, procedural guidance, training, and personnel experience placed initial emphasis on expected plant response rather than actual plant conditions.

When the Steam Generator Feedwater Pump 13 tripped, the initial actions contained in the "Loss of Feedwater Flow or Control" procedure were performed. These actions, which included verifying the Start-up Feedwater Pump had automatically started and starting a Feedwater Booster Pump, emphasized responding to the initiating event rather than actual plant conditions. Licensed Operator training and previous similar experience resulted in placing emphasis on expecting the Steam Generator levels to return to normal within a short period of time. The improper procedure emphasis and training caused a delay (90 seconds) in proper diagnoses which prevented averting a low-low Steam Generator level reactor trip.

Additional contributing causes:

1. Upon recognition of the need to decrease turbine load, inadequate communications delayed the actual reduction in turbine load.
2. This event was initiated when Steam Generator Feedwater Pump 13 tripped on overspeed. The cause was determined to be a failed speed feedback device (Tachometer Pack) in the turbine speed control circuits. The speed control circuits require a speed feedback signal to balance its output and maintain the desired speed. The feedback device failed in such a way that the speed signal provided to the controls was lower than the actual running speed of the machine. With this false running speed signal, the control circuits

demanded more speed (opened the low pressure governor valve) in an attempt to bring the failed speed signal up to match the speed demand signal. The controller continued to increase the machine's actual speed until the electrical overspeed setpoint was reached.

3. The cause of the start-up feedwater pump recirculation valve not closing was a coarse gain misadjustment on the flow controller card in the miscellaneous analog cabinet. The function of the Start-Up Feedwater Pump Recirculation valve is to ensure adequate flow for the Start-Up Feedwater Pump. This ensures a minimum flow of 3300 gallons per minute with the valve going fully closed at 7000 gallons per minute. The flow controller card was changed from a proportional-integral to a proportional only in 1991, in response to a problem with erratic response between the controller and the low flow switch of this valve. In March 1994, as allowed by maintenance procedures and management expectations, the loop gain was reduced to 0.78 in response to a hunting problem identified earlier that month. The post-maintenance testing of this work was deemed to be adequate based on the work performed.

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CAUSE OF EVENT (Continued):

The affect of the gain reduction to 0.78, with the reset function bypassed changed the full closure setting to 12000 gallons per minute. As a result, the valve remained approximately 61 % open for the duration of the event. Had the reset function not been bypassed, the valve may have modulated closed, even at flow rates that were experienced during this event. A review of the data shows that the valve was passing approximately 2500 gallons per minute (or 6% of rated feedwater flow), which correlates with the observed feedwater flow/steam flow mismatches a few minutes into the transient.

The personnel performing this work were unaware of this modification because training on the modification was determined to be unnecessary for Instrumentation and Control Technicians since the appropriate drawings and procedures had been updated. Current procedures and management expectations allow tuning of controllers without detailed work instructions.

A review of this valve's equipment history identified recurring problems of erratic control and valve binding for several years.

During troubleshooting to determine the cause of the current failure, binding was again noted in the valve. A complete disassembly of the valve was performed and internal valve damage was present. The cause of the valve damage and binding was attributed to substantially low hardness of the cage interior and failed seal rings. The valve was reassembled with parts with the correct hardness and the control circuit was calibrated. The valve was stroked to ensure proper operation.

ANALYSIS OF EVENT:

Reactor Trips and Engineered Safety Features actuations are reportable pursuant to 10CFR50.73(a)(2)(iv). All Engineered Safety Features systems functioned as designed. Auxiliary Feedwater actuated on low Steam Generator level and Feedwater Isolation actuated on low average temperature average coincident with a reactor trip. There were no adverse safety or radiological consequences of this event.

CORRECTIVE ACTIONS:

The following corrective actions have been taken or will be taken as a result of this event:

1. Management expectations regarding the use of all indications for proper equipment operation and crew communications were discussed with the involved crew.
2. The off-normal procedure, "Loss of Feedwater Flow or Control", was revised to respond to actual plant conditions and stabilize the plant to permit event analysis.

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CORRECTIVE ACTIONS (Continued):

3. The failed speed sensor was replaced. A design modification to replace the Feedwater Pump Turbine speed controls is scheduled to be implemented during the next refueling. This modification also eliminates this sensor and similar ones from the control circuit. This modification was implemented in Unit 2 during the last refueling outage.
4. The Start-Up Feedwater Pump Recirculation Valve was reassembled with parts with the correct hardness and the control circuit was

calibrated. The valve was stroked to ensure proper operation.

5. Additional analysis is being performed on the recirculation valve to identify the failure mechanism. This analysis will also review similar make valves to identify common-mode failures. This analysis will be completed by December 29, 1994. Corrective actions will be developed as necessary.

6. Instrumentation and Control personnel have been made aware of the modification which removed the reset function from the Start-Up Feedwater Pump Recirculation valve controller. Significant changes have been made to the modification process which will help preclude similar occurrences. Additionally, as part of the lessons learned from this event, management has reiterated the need to ensure component configuration prior to commencing work which does not require detailed work instructions.

7. A scenario similar to this event is being developed for use on the simulator. This will be completed by July 31, 1995. This date coincides with the installation and operation of a new simulator which can support the modeling of this scenario.

8. This event will be included in Operator lessons-learned training by February 28, 1995. Although using all indications to verify successful equipment operation and the use of adequate crew communications is continuously emphasized, lessons-learned training will re-emphasize these topics.

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ADDITIONAL INFORMATION:

Previous events that have been reported by the South Texas Project to the Nuclear Regulatory Commission within the last three years regarding a reactor trip as a result of low Steam Generator level were:

- o Unit 2 Licensee Event Report 92-003 regarding a reactor trip on February 24, 1992. The cause of that event was attributed to rainwater intrusion through the expansion joints in the Turbine Generator Building roof and into the Electro-hydraulic Control cabinet.

- o Unit 2 Licensee Event Report 93-004 regarding a reactor trip due to low Steam Generator water level. The cause of that event was

determined to be ineffective action to correct failures of the Start-up Steam Generator Feedwater pumps, Steam-Driven Feedwater pumps and Feedwater Isolation Bypass valves. The failure to effectively correct the root cause of these problems resulted in unnecessary loss of availability and reduced unit reliability.

o Unit 1 Licensee Event Report 94-009 regarding a manual reactor trip due to low Steam Generator water level. The cause of that event was an I/P convertor failure in the control loop for the 1D feedwater regulating valve.

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The Light
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Houston Lighting & Power Wadsworth, Texas 77483

November 17, 1994
ST-HL-AE-4935
File No.: G26
10CFR50.73

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

South Texas Project
Unit 1
Docket No. STN 50-498
Revision 1 to Licensee Event Report 94-015
Reactor Trip and Turbine Trip due to
Low-Low Steam Generator Level

Pursuant to 10CFR50.73, Houston Lighting & Power submits the attached revision to Unit 1 Licensee Event Report 94-015 regarding a reactor trip and turbine trip due to low-low Steam Generator level. This event did not have an adverse effect on the health and safety of the public, but clearly does not meet the standards for expected operational performance.

This revision documents the additional investigation and additional corrective actions associated with the misadjustment problem of the Start-Up Feedwater Pump Recirculation Valve Control Circuit. Changes are indicated by revision bars.

If you should have any questions on this matter, please contact Mr.
J. M. Pinzon at (512)972-8027 or me at (512) 972-8664.

J. F. Groth
Vice President,
Nuclear Generation

JMP/pas

Attachment: Revision 1 to LER 94-015 (South Texas, Unit 1)

LER-
4L94015R1-U1 11/17/94 (9:50am)

Project Manager on Behalf of the Participants in the South Texas Project

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South Texas Project Electric Generating Station File No.: G26
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